THE CLAIMS

What is claimed is:

1. An apparatus for storing and dispensing a sorbate gas, wherein the sorbate gas undergoes decomposition to form hydrogen gas, said apparatus comprising:

   (a) a storage and dispensing vessel containing the sorbate gas in a physically adsorbed state; and

   (b) a decomposition chamber, said decomposition chamber comprising a decomposition portion and a collection portion, wherein the storage and dispensing vessel is communicatively connected to the decomposition portion, and wherein the decomposition portion and the collection portion are separated by a gas permeable membrane.

2. The apparatus of claim 1, wherein the storage and dispensing vessel comprises:

   (a) a vessel constructed and arranged for holding a solid-phase physical sorbent medium;

   (b) a solid-phase physical sorbent medium disposed in said vessel at an interior gas pressure;

   (c) a sorbate gas physically adsorbed on said solid-phase physical sorbent medium; and

   (d) a dispensing assembly coupled in gas flow communication with the vessel;

   wherein at least a portion of the sorbate gas desorbs from the solid-phase physical sorbent medium under dispensing conditions to yield desorbed sorbate gas for flow of said desorbed sorbate gas through the dispensing assembly.

3. The apparatus of claim 1, wherein the sorbate gas comprises a gaseous hydride.

4. The apparatus of claim 3, wherein the gaseous hydride comprises a hydride selected from the group consisting of silane, germane, stibine and diborane.

5. The apparatus of claim 3, wherein the gaseous hydride comprises silane.

6. The apparatus of claim 2, wherein the solid-phase physical sorbent medium disposed in said vessel comprises a material selected from the group consisting of silica, carbon molecular sieves, alumina, macroreticulate polymers, kieselguhr, carbon, and aluminosilicates.

7. The apparatus of claim 1, wherein the gas permeable membrane is selective for hydrogen over the sorbate gas.

8. The apparatus of claim 1, wherein the gas permeable membrane comprises perfluorosulfonic acid.

9. The apparatus of claim 1, further comprising a modified surface adsorbent in the decomposition portion of the decomposition chamber.

10. The apparatus of claim 9, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent.

11. The apparatus of claim 9, wherein the modified surface adsorbent comprises a boric acid doped carbon adsorbent.

12. The apparatus of claim 1, further comprising a fuel cell communicatively connected to the collection portion of the decomposition chamber, wherein the fuel cell is positioned downstream of the collection portion of the decomposition chamber.

13. The apparatus of claim 1, wherein the gas sorbate decomposes in the storage and dispensing vessel.

14. The apparatus of claim 1, wherein the gas sorbate decomposes in the decomposition portion of the decomposition chamber.

15. The apparatus of claim 2, wherein the dispensing assembly comprises at least one gas regulator positioned between the storage and dispensing vessel and the decomposition chamber.

16. The apparatus of claim 2, wherein the dispensing assembly comprises at least one gas regulator disposed within the vessel.

17. The apparatus of claim 2, wherein the interior gas pressure is subatmospheric.

18. The apparatus of claim 2, wherein the interior gas pressure is atmospheric.

19. The apparatus of claim 2, further comprising a heater operatively arranged in relation to the vessel for selective heating of the solid-phase physical sorbent medium, to effect thermally-enhanced desorption of at least a portion of the sorbate gas from the solid-phase physical sorbent medium.

20. The apparatus of claim 2, wherein the vessel is constructed and arranged to effect desorption of at least a portion of said sorbate gas from the solid-phase physical sorbent medium under dispensing conditions including a pressure exterior of said vessel below said interior pressure.

21. The apparatus of claim 2, wherein the solid-phase physical sorbent medium comprises a modified surface adsorbent.

22. The apparatus of claim 21, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent or a boric acid doped carbon adsorbent.

23. The apparatus of claim 1, wherein the sorbate gas decomposes at room temperature.

24. The apparatus of claim 3, wherein the gaseous hydride generates hydrogen gas and metal upon decomposition.

25. The apparatus of claim 24, wherein the metal comprises a species selected from the group consisting of silicon, germanium, boron and antimony.

26. The apparatus of claim 24, wherein the metal is at least partially regeneratable to the gaseous hydride.

27. The apparatus of claim 1, further comprising a hydrogen-containing source communicatively connected to the collection portion of the decomposition chamber.

28. An apparatus for storing, dispensing and regenerating a sorbate gas, said apparatus comprising:

(a) a storage and dispensing vessel containing the sorbate gas in a physically adsorbed state;

(b) a decomposition chamber, said decomposition chamber comprising a decomposition portion and a collection portion separated by a gas permeable membrane, said decomposition portion having a modified surface adsorbent disposed therein, wherein the storage and dispensing vessel is communicatively connected to the decomposition portion of the decomposition chamber, and wherein the sorbate gas undergoes decomposition in the decomposition chamber to form a metal and hydrogen gas therein; and

(c) a hydrogen-containing source communicatively connected to the collection portion of the decomposition chamber.

29. The apparatus of claim 28, wherein the hydrogen-containing source supplies hydrogen to the decomposition chamber to re-hydride at least a portion of the metal contained therein.

30. The apparatus of claim 29, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent or a boric acid doped carbon adsorbent.

31. The apparatus of claim 28, wherein the sorbate gas comprises a gaseous hydride.

32. The apparatus of claim 31, wherein the gaseous hydride comprises a species selected from the group consisting of silane, germane, stibine and diborane.

33. The apparatus of claim 28, wherein the gas permeable membrane is selective for hydrogen over the sorbate gas.

34. The apparatus of claim 28, wherein the gas permeable membrane comprises perfluorosulfonic acid.

35. The apparatus of claim 28, wherein the sorbate gas decomposes at room temperature.

36. An apparatus for storing and dispensing a sorbate gas, said apparatus comprising a storage and dispensing vessel containing the sorbate gas, said storage and dispensing vessel comprising:

(a) a vessel constructed and arranged for holding a solid-phase physical sorbent medium;

(b) a solid-phase physical sorbent medium disposed in said vessel at an interior gas pressure;

(c) a sorbate gas physically adsorbed on said solid-phase physical sorbent medium; and

(d)' a dispensing assembly coupled in gas flow communication with the vessel and selectively actuatable for gas dispensing, wherein the dispensing assembly comprises a gas permeable membrane within the vessel,

wherein at least a portion of the sorbate gas undergoes decomposition in the vessel to form hydrogen gas, and hydrogen gas egresses the vessel through the gas permeable membrane of the dispensing assembly during said gas dispensing.

37. The apparatus of claim 36, wherein the sorbate gas comprises a gaseous hydride.

38. The apparatus of claim 37, wherein the gaseous hydride comprises a species selected from the group consisting of silane, germane, stibine and diborane.

39. The apparatus of claim 36, wherein the solid-phase physical sorbent medium disposed in said vessel comprises a material selected from the group consisting of silica, carbon molecular sieves, alumina, macroreticulate polymers, kieselguhr, carbon, and aluminosilicates.

40. The apparatus of claim 36, wherein the solid-phase physical sorbent medium comprises a modified surface adsorbent.

41. The apparatus of claim 40, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent or a boric acid doped carbon adsorbent.

42. The apparatus of claim 36, wherein the gas permeable membrane is selective for hydrogen over the sorbate gas.

43. The apparatus of claim 36, wherein the gas permeable membrane comprises perfluorosulfonic acid.

44. The apparatus of claim 36, further comprising a fuel cell communicatively connected downstream of the storage and dispensing vessel.

45. The apparatus of claim 36, wherein the dispensing assembly comprises at least one gas regulator disposed within the vessel.

46. The apparatus of claim 36, wherein the interior gas pressure is subatmospheric.

47. The apparatus of claim 36, wherein the interior gas pressure is atmospheric.

48. The apparatus of claim 36, wherein the vessel is constructed and arranged to effect desorption of at least a portion of said sorbate gas from the solid-phase physical sorbent medium under dispensing conditions including a pressure exterior of said vessel below said interior pressure.

49. The apparatus of claim 36, wherein the sorbate gas decomposes at room temperature.

50. A method for generating hydrogen gas by the decomposition of a sorbate gas, said method comprising:

(a) desorbing at least a portion of said sorbate gas from a solid-phase physical sorbent medium disposed in a storage and dispensing vessel, said storage and dispensing vessel comprising a solid-phase physical sorbent medium having a physically sorptive affinity for said sorbate gas disposed therein;

(b) flowing the sorbate gas from the storage and dispensing vessel to a decomposition chamber; and

(c) decomposing the sorbate gas in the decomposition chamber to generate hydrogen gas.

51. The method of claim 50, wherein the sorbate gas is desorbed from the solid-phase physical sorbent medium by reduced pressure desorption.

52. The method of claim 50, wherein the sorbate gas is desorbed from the solid-phase physical sorbent medium by thermally-enhanced desorption.

53. The method of claim 50, wherein the sorbate gas comprises a gaseous hydride.

54. The method of claim 53, wherein the gaseous hydride comprises a species selected from the group consisting of silane, germane, stibine and diborane.

55. The method of claim 53, wherein the gaseous hydride comprises silane.

56. The method of claim 50, wherein the solid-phase physical sorbent medium comprises a material selected from the group consisting of silica, carbon molecular sieves, alumina, macroreticulate polymers, kieselguhr, carbon, and aluminosilicates.

57. The method of claim 50, wherein the solid-phase physical sorbent medium comprises a modified surface adsorbent.

58. The method of claim 57, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent or a boric acid doped carbon adsorbent.

59. The method of claim 50, wherein the decomposition chamber comprises a decomposition portion and a collection portion which are separated by a gas permeable membrane.

60. The method of claim 59, wherein the gas permeable membrane is selective for hydrogen over the sorbate gas.

61. The method of claim 59, wherein the gas permeable membrane comprises perfluorosulfonic acid.

62. The method of claim 59, further comprising flowing the hydrogen gas into a fuel cell that is communicatively connected to the collection portion of the decomposition chamber.

63. The method of claim 50, wherein the storage and dispensing vessel comprises a dispensing assembly.

64. The method of claim 63, wherein the dispensing assembly comprises at least one gas regulator positioned between the storage and dispensing vessel and the decomposition chamber.

65. The method of claim 63, wherein the dispensing assembly comprises at least one gas regulator disposed within the storage and dispensing vessel.

66. The method of claim 50, wherein the sorbate gas decomposes at room temperature.

67. The method of claim 53, wherein the gaseous hydride generates hydrogen gas and metal upon decomposition.

68. The method of claim 67, further comprising regenerating the metal by introducing hydrogen from a hydrogen-containing source to the decomposition chamber to re-hydride the metal.

69. The method of claim 50, further comprising flowing the hydrogen gas to a fuel cell.

70. The method of claim 50, wherein the solid-phase physical sorbent medium has physically sorptive affinity for said sorbate gas disposed therein.

71. The method of claim 50, wherein the gas sorbate decomposes in the storage and dispensing vessel.

72. The method of claim 59, wherein the gas sorbate decomposes in the decomposition portion of the decomposition chamber.

73. A method for generating hydrogen gas by the decomposition of a sorbate gas, said method comprising:

(a) physically adsorbing a sorbate gas into a solid-phase physical sorbent medium having sorptive affinity for said sorbate gas, wherein the solid-phase physical sorbent medium is disposed in a storage and dispensing vessel comprising a dispensing assembly;

(b) decomposing at least a portion of said sorbate gas physically adsorbed into the solid-phase physical sorbent medium to form hydrogen; and

(c) flowing the hydrogen gas from the storage and dispensing vessel to a hydrogen gas consuming unit.

74. The method of claim 73, wherein the dispensing assembly of the storage and dispensing vessel includes a gas permeable membrane to separate the sorbate gas from hydrogen gas.

75. The method of claim 73, wherein the sorbate gas comprises a gaseous hydride.

76. The method of claim 75, wherein the gaseous hydride comprises a species selected from the group consisting of silane, germane, stibine and diborane.

77. The method of claim 73, wherein the solid-phase physical sorbent medium disposed in said vessel comprises a material selected from the group consisting of silica, carbon molecular sieves, alumina, macroreticulate polymers, kieselguhr, carbon, and aluminosilicates.

78. The method of claim 73, wherein the solid-phase physical sorbent medium comprises a modified surface adsorbent.

79. The method of claim 78, wherein the modified surface adsorbent comprises a phosphoric acid doped carbon adsorbent or a boric acid doped carbon adsorbent.

80. The method of claim 74, wherein the gas permeable membrane is selective for hydrogen over the sorbate gas.

81. The method of claim 74, wherein the gas permeable membrane comprises perfluorosulfonic acid.

82. The method of claim 74, wherein the hydrogen gas consuming unit comprises a fuel cell.

83. The apparatus of claim 74, wherein the sorbate gas decomposes at room temperature.